REMARKS

Status of Amendments

Claims 14, 26 and 27 are amended to give further details of the pushbroom imaging technique, supported in the disclosure at paragraphs 25 and 26, and Fig. 4.

Claim 16 is amended to direct the detection technique to ethane.

Claim 18 is amended to define an aspect of the beam splitter as previously claimed in claim 19, and shown in Fig. 2. Claim 19 is cancelled as a consequence.

Claim 21 is amended to incorporate the elements of its base claim, and relax the bandwidth constraint to be consistent with Claims 22 and 23.

Claims 22 and 23 are amended to depend from claim 21.

Claims 28-31 are added to include a feature from paragraphs 27-32 of the disclosure.

Claims 1-18 and 20-31 are now pending in the application. Reconsideration of the application and allowance of the claims is requested.

Claim Rejections

Claims 1-5, 11, 12, 13, 15, 16, 18, 24, 25 and 26 of the present application are rejected under 35 USC 102(e) as being anticipated by Nelson et al ("Nelson", US Patent no. 6,750,453) and claims 2, 3, 4, 7, 8 and 9 of the present application are rejected under 35 U.S.C. § 103(a) based on Nelson et al. Applicants respectfully traverse this rejection.

In respect of Claims 1-17, applicants submit herewith the declaration of Boyd T. Tolton, one of the inventors of the present application, claiming conception and reduction to practice of the claimed invention of at least Claims 1 and 2 prior to the earliest effective date of the Nelson patent. This declaration is submitted pursuant to 37 C.F.R. §1.131. It is submitted that this declaration removes Nelson as citable prior art and thus overcomes the rejection of Claims 1-17.

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Further, in respect of Claims 3, 4, 8, 9 and 21-23, Nelson et al does not disclose the claimed bandwidth. The novelty and unobviousness of the applicants' claimed bandwidth is discussed in paragraph 24 of the present disclosure with reference to Fig. 5.

Nelson (6,750,453) discloses a bandwidth between 2970 and 3005 cm-1, and the examiner stated that *"discovering the optimal or workable ranges involves only routine skill in the art."* However, Nelson discloses the narrow 2970 to 3005 cm-1 region since that section of the spectrum has the strongest ethane absorption features, as shown in Fig. 5 of the present disclosure. These features are well known from the Hitran database and have been used to measure the concentration of ethane in the atmosphere.

However, the applicants claim a much wider spectral region, surrounding this spectral region. The reason for doing this is that the applicants discovered that absorption features of ethane (i.e., absorption lines) are much wider than is publicly known. Although these spectral absorption features are not as strong as the narrow 2970 to 3005 cm-1 region, they are still very strong. Also, by widening the spectral passband to 3000 ± 150 cm-1, the applicants significantly increase the amount of energy collected by the system. With increased energy (i.e., signal), the applicants increased the effective resolution of the measurement (i.e., increased sensitivity).

The applicants suspect that Nelson chose the 2970 to 3005 cm-1 region because that is what is publicly known through the Hitran database. The middle plot of applicants' Fig. 5 shows the measured absorption 12.1 kPa of ethane in a 28.6 mm gas cell as carried out by the applicants. The bottom plot shows a calculation of the same gas cell, using line data from the Hitran2000 database, which corresponds essentially to Nelson's selected bandwidth of 2970 to 3005 cm-1. These figures clearly show the difference between what was known about ethane absorption according to the Hitran database and the applicants' claimed bandwidth. The applicants' selected region covers the previous unknown but much wider ethane band. It is

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submitted that for this contribution to the art, applicants are entitled to a patent, and Claims 3, 4, 8, 9 and 21-23 should be patentable over Nelson et al.

Further, in respect of Claims 14, 26 and 27, the examiner correctly observes that Nelson et al do not expressly disclose a pushbroom technique, but then goes on to conclude that it is obvious that Nelson et al must be doing so. Applicants have amended these claims to refer to simultaneous detection of plural pixels, and observe that Nelson et al do not anywhere disclose or suggest using multiple pixels in a line sampled simultaneously.

Claims 6, 10, and 19-23 of the present application are rejected under 35 U.S.C. § 103(a) based on Nelson et al. in view of Sache et al. Applicants respectfully traverse this rejection.

In respect of Claims 6, 10, 18, 20, 24 and 25, applicants have claimed the use of a bi-prism. Neither Nelson et al, nor Sache et al, disclose a bi-prism. Sache et al, US 6,574,031 discloses that a prism can be used to perform partitioning. While this is technically correct, the prism of Sache et al is not said to be a bi-prism. Sache et al appear to disclose the use of a single wedge prism, which has a partially reflecting coating on the front surface. The received energy is partitioned into reflected and transmitted components. Optically, all that a single prism does is "bend" the direction that light travels through a system. Partitioning is performed by separating the reflected component(s) from the transmitted. Light separation with a single prism has a significant problem in that the transmitted and the reflected beams are partially polarized.

In the claimed bi-prism, light is not partitioned using a reflected component, but instead partitioned using the transmitted components of two prisms. As shown in Fig. 2 of the present disclosure, the energy passing through the system is partitioned biaxially. Energy passing through each half of the optical chain are imaged offset from each other. The distance between the images is a function of the angle of the prisms. This technique minimizes polarization

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problems, partly due to the fact that the angles of the prism surfaces relative to the optical axis are small. Nothing in either cited reference teaches or suggests the use of a bi-prism.

In respect of new Claims 28-31, Nelson et al do not disclose use of background radiation. The Nelson et al patent claims a GFCR instrument with an aircraft mounted radiation source. The energy from this source is separated from the background thermal emission and reflected solar radiation by chopping or modulating the beam. In this manner, Nelson et al is measuring only the part of the atmosphere between the aircraft and the surface.

In applicants' claimed method, the upwelling ambient background radiation (both reflected solar and thermal emission from the surface and atmosphere) is measured. As such, the applicants measure the entire atmospheric column. As a result, applicants' method has very little sensitivity to methane, but is sensitive to ethane.

Methane exists naturally in the atmosphere at an average concentration of about 1.8 ppm. If all the methane in the atmosphere was brought to the surface, it would make a layer approximately 15 mm thick. Consequently, the detection of a small leak of methane (with an equivalent thickness of microns) on a background that is 4 orders of magnitude larger is a very difficult problem.

Applicants' invention as claimed in Claims 28-31 detects natural gas by detecting the presence of ethane in the atmosphere using ambient background radiation. The natural background of ethane is three orders of magnitude smaller ($\approx$1ppb if brought to the surface) than methane ($\approx$ 1.8 ppm). By using the "natural" upwelling radiance to measure the ethane concentration, applicants do not need the added complexity and power requirements of an aircraft mounted radiation source. The power required for the source is easily more than can be provided by a typical aircraft. Accordingly, new Claims 28-31 are believed to be patentable over Nelson et al.

Respectfully submitted,

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